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Bulletin of the

# Taylor Society

## A Society to Promote the Science of Management

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### OFFICERS OF THE SOCIETY

*President* (1917) Harlow S. Person, Hanover, N. H.

*Vice-President* (1917) Morris L. Cooke, 401 West Walnut Lane, Germantown, Pa.

*Vice-President* (1918) George D. Babcock, H. H. Franklin Mfg. Co., Syracuse, N. Y.

*Secretary* (1917) Henry W. Shelton, 35 College St., Hanover, N. H.

*Treasurer* (1917) H. K. Hathaway, 18th and Hamilton Sts., Philadelphia, Pa.

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All the officers, *ex-officio*.

Arthur E. Barter (1917), Norwood, Mass.

Dwight V. Merrick (1918) 34 Gramercy Park, New York City.

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### COMING MEETINGS

#### MARCH 2nd and 3rd

The next meeting of the Society will be held in Boston, Friday and Saturday, March 2nd and 3rd. A summary of the program follows:

*Friday, March 2nd.*

8.00 P. M.—"Maintenance of Machines and Equipment as a part of the Taylor System of Management."
By H. K. Hathaway, Vice-President, Tabor Mfg. Co., Philadelphia, Pa.

*Saturday, March 3rd.*

8.00 A. M.—Visit to plant of Waltham Watch Co. Waltham, Mass.

12.30 P. M.—Luncheon.

2.00 P. M.—"The Tabor Beneficial Society."
By Herman J. Hutkin and Nathaniel Johnson, Tabor Mfg. Co., Philadelphia, Pa.

"The Manager, the Workman and the Social Scientist."
By H. S. Person, President of the Society and Director, Amos Tuck School of Administration and Finance, Dartmouth College, Hanover, N. H.

6.30 P. M.—Dinner.

8.00 P. M.—Discussion of the papers of the afternoon session.

All of the sessions will as usual be open to guests, including ladies. Members are requested to send to the secretary as soon as possible the names and addresses of any guests to whom invitations should be sent. Additional information about local arrangements may be secured from Mr. A. E. Barter, The Plimpton Press, Norwood, Mass.

#### MAY 18th and 19th

The spring meeting of the Society will be held in Syracuse at the Hotel Onondaga, Friday and Saturday, May 18 and 19. A summary of the program as tentatively arranged follows:

*Friday, May 18th.*

8.00 P. M.—Papers describing certain management mechanisms which will be seen in use in the Franklin Automobile plant on the visit Saturday morning. These include:
"Routing."
"Schedules and Control, including Operation of Control Board."
"Despatching, involving Pneumatic Tubes and Material Transportation."
"Employment Work."

*Saturday, May 19th*

9.30 A. M.—Visit to plant of Franklin Automobile Company.

12.30 P. M.—Luncheon, Hotel Onondaga.

2.00 P. M.—"Wage Rating."
By George D. Babcock, Production Manager, Franklin Automobile Co., Syracuse, N. Y.

6.30 P. M.—Dinner, Hotel Onondaga.

8.00 P. M.—"Who Is Boss in Your Shop."
By Morris L. Cooke, Consulting Engineer, Philadelphia, Pa.

Headquarters for this meeting will be at Hotel Onondaga, East Jefferson and Warren Sts., Syracuse, N. Y. Rooms should be reserved not later than May 11th.

All of the sessions will as usual be open to guests, including ladies. Members are requested to send to the secretary, as soon as possible, the names of guests who should be invited. Additional information as to local arrangements may be obtained from the chairman of the local committee, Mr. George D. Babcock, Franklin Automobile Co., Syracuse, N. Y.

## COMMENT AND NEWS

The annual meeting of the Society, held in New York City, December 8 and 9, 1916, made a new record for both attendance and interest. At some of the sessions there was standing room only and in every case the necessary time limits precluded many who wished to take part in the discussion from doing so.

The paper on "The Application of Scientific Management to Professional Work in Hospitals and Doctors' Offices" by Doctor Robert L. Dickinson of Brooklyn, N. Y., was unique in its presentation and discussion and left no doubt in the minds of those present as to the need for and possibility of applying the Taylor principles in medical and surgical work. Doctor Dickinson made a stirring appeal, seconded by several of those who discussed it, including Doctor E. A. Codman of Boston; Commissioner of Public Health, H. C. Wright of New York; and others for the cooperation of the trained engineers in helping solve problems so closely connected with human life. Doctor Dickinson's paper with discussion will be published in an early number of the Bulletin.

Saturday morning, Mr. Walter N. Polakov presented his able paper on "Planning of Power Plant Work" which will be published in the next issue of the Bulletin, Vol. II, No. 6.

After luncheon at the Hofbrau House, the paper on "Scientific Management and Progress" by Horace B. Drury of Ohio State University, published in Volume II, No. 4 of the Bulletin, was read by title and discussion opened by Lieutenant Frederic G. Coburn of the Harvard Graduate School of Business Administration, who was followed by Professor Joseph H. Willits, University of Pennsylvania, Philadelphia, Pa.; Professor Robert M. Haig, Columbia University School of Business, New York City; and Henry L. Gantt, Consulting Engineer, New York City.

After dinner, Mr. Paul B. Valle of the Acme Co., New Haven, Conn., gave a short paper on "Discipline on the Border" which was to have been followed by a paper by Morris L. Cooke of Philadelphia on "Who is Boss in your Shop." Mr. Cook's unfortunate illness, which prevented his being present or even completing his paper, made it necessary to devote the rest of the entire evening to a discussion of the general subject of the relation between employer and employee. Those invited to discuss Mr. Cooke's paper took part and the interest grew so intense that the meeting was not disbanded until 11:45 P. M., and after that several groups continued the discussion into the early morning hours. Mr. Robert B. Wolf, manager of manufacturing of the Burgess Sulphite Fibre Co., Berlin, N. H. opened the discussion and was followed by Mr. George D. Babcock, Production Manager of the Franklin Automobile Co., Syracuse, N. Y.; Mr. A. J. Portenar, Supt., New York State Employment Bureau, Brooklyn, N. Y.; Mr. Richard A. Feiss, general manager of the Clothcraft Shops of the Joseph & Feiss Co., Cleveland, Ohio; Mr. Edwin Devine, secretary, New York School of Philanthropy; and Mr. Henry P. Kendall, Boston, Mass.

Mrs. Taylor showed her continued interest by attending several of the sessions, which were attended by a number of other ladies also. The Society realizes the increasing contribution which women can make to the success of its meetings and the solution of its problems. This was given emphasis by the able discussion of Doctor Dickinson's paper, Friday evening, by Miss Annie Goodrich, Assistant Professor Nursing and Health, Teachers College, New York.

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At the business meeting, called to order by President Person, the election of the following new officers was announced. For Vice-President, to serve two years to succeed Charles Day, George D. Babcock; for Member of Governing Board, to serve two years to succeed S. E. Thompson, Dwight V. Merrick; for Members of Membership Committee, to serve three years to succeed H. V. R. Scheel and Richard A. Feiss, H. V. R. Scheel and Richard A. Feiss. Messrs. Wolf, Kendall, Feiss, Coburn and Shipley were elected as Nominating Committee to nominate officers for the next annual meeting.

Mr. Sanford E. Thompson, for the committee on sustaining memberships, reported that ten firms had already signified their desire to become contributors of $100. a year each to further the work of the Society.

An invitation, extended by Mr. Folsom of the Waltham Watch Co., Waltham, Mass., to visit their plant during the Boston meeting, was accepted.

At the suggestion of Mr. Kendall, the Society instructed the President to appoint a committee of three to draw up suitable resolutions on the death of Prof. R. F. Hoxie and Mr. Robert G. Valentine, expressing the appreciation of the work they did in advancing Scientific Management, copies to be sent to their families and friends.

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Any member or friend of the Society who has any interesting personal anecdotes concerning Mr. Taylor, or anything that would be of interest and value for inclusion in his biography, is asked to send it to Mr. F. B. Copley, %F. W. Taylor Cooperators, "Boxly", Highland Station, Chestnut Hill, Philadelphia, Pa., who is preparing the biography of Mr. Taylor.

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**The attention of members is called also to the fact that "Industrial Management Magazine" (formerly**

"Engineering Magazine") has established a department which will each month present material concerning the human element in industry.

"The Taylor System in Franklin Management" is the title of an important series of articles by George D. Babcock, Vice-President of the Society and Production Manager of the Franklin Automobile Co., Syracuse, N. Y., concluded in the January issue of Industrial Management Magazine.

In the November 1916 issue (Volume I, No. 8) of the Utilities Magazine is a valuable and suggestive paper on "The Nationalization of the Private Utility Interests" by Morris L. Cooke, Vice-President of the Society. This paper is the substance of two addresses recently given by Mr. Cooke in the middle West.

There is an opening for an assistant superintendent of a machine shop in Youngstown, Ohio, not operated under the Taylor System. Salary about $2500. Anyone interested, upon communicating with the secretary, will be referred to the concern.

Mr. Robert B. Wolf has resigned from his position as Manager of Manufacturing of the Burgess Sulphite Fibre Company to become Vice-President and Manager of the Spanish River Pulp and Paper Co., Sault Ste. Marie, Ontario, Canada.

Mr. R. B. Fraser has left Chicago, where for several years he has been associated with the Sewell-Clapp Envelope Co., to become Production Engineer of the Winchester Repeating Arms Co., New Haven, Conn.

Mr. Keppele Hall is now associated with Sanford E. Thompson in Boston.

## PROFIT SHARING

### WHY IT WILL NOT SOLVE THE DIFFICULTIES BETWEEN CAPITAL AND LABOR. A PERSONAL LETTER WRITTEN BY THE LATE FREDERICK WINSLOW TAYLOR

August 22, 1912.

Mr. George Elbert Taylor,
Calumet Club,
267 Fifth Avenue,
New York City.

My dear Mr. Taylor:—

I have read through your plan for profit sharing with the very greatest of interest, and I want to congratulate you upon the most complete and thorough way in which you have thought out every detail of your scheme, as well as upon the lucid and most interesting way in which you have described every feature of it. You have certainly presented the most carefully thought out and elaborated scheme of profit sharing that has ever come to my attention.

Since receiving your paper, I have again given a great deal of thought to the whole subject, and wind up where I started, with the firm conviction that the satisfactory and final solution of the difficulties between employers and employes will not be made through profit sharing. I beg to quote you from a paper on "A Piece Rate System," written by me in 1895, as follows, on profit sharing:

"Co-operation, or profit sharing, has entered the mind of every student of the subject as one of the possible and most attractive solutions of the problem; and there have been certain instances, both in England and France, of at least a partial success of co-operative experiments.

"So far as I know, however, these trials have been made either in small towns, remote from the manufacturing centres, or in industries which in many respects are not subject to ordinary manufacturing conditions.

"Co-operative experiments have failed, and I think, are generally destined to fail, for several reasons, the first and most important of which is, that no form of co-operation has yet been devised in which each individual is allowed free scope for his personal ambition. Personal ambition always has been and will remain a more powerful incentive to exertion than a desire for the general welfare. A few misplaced drones, who do the loafing and share equally in the profit with the rest, under co-operation are sure to drag the better men down towards their level.

"The second and almost equally strong reason for failure lies in the remoteness of the reward. The average workman (I don't say all men) cannot look forward to a profit which is six months or a year away. The nice time which they are sure to have today, if they take things easily, proves more attractive than hard work, with a possible reward to be shared with others six months later.

"Other and formidable difficulties in the path of co-operation are, the equitable division of the profits, and the fact, while workmen are always ready to share the profits, they are neither able nor willing to share the losses. Further than this, in many cases, it is neither right nor just that they share either in the profits or the losses, since these may be due in great part to causes entirely beyond their influence or control, and to which they do not contribute."

I quote this as giving merely a bird's eye view of my study of profit sharing. No single element touched upon by me in these few words is at all satisfactorily treated, and yet I still retain the same views that I had when this was written in 1895.

There are a number of elements which I have not touched upon in this quotation, and which in my judgment form the very essence of the objection to profit sharing. The first of these is that so far as I am able to find out, capital is not, on the average, generally speaking, receiving at the present time more than its fair share of the joint return given to capital and labor. And the eyes of the laboring people are continually directed to the wrong spot when they are focussed upon the great and unjust rewards which capital is now receiving.

I feel very certain that one of the greatest misfortunes under which laboring people now are suffering, is that they are not correctly informed on this very subject. One of the most illuminating articles that I have ever read appeared in the June *Atlantic Monthly*, and was written by Mr. Chas. Norman Fay. It begins on Page 758. I am sending you an extra copy of this number, which I have procured. The apparently reliable statistics given towards the end of this paper constitute, to my mind, its very great value, and show, for instance, that if the entire reward which now goes to capital were divided equally among all the working people of the country, the average head of the family could receive an addition of only 60 cents a day to his wages.

That means that if the entire reward now received by capital were divided equally among all the people in the United States, each individual would receive only 13 cents a day.

Now I have not the slightest idea that the ordinary mechanic or employee of a company knows the facts in this case. He is under the impression, as I was to a large extent, that capital received entirely too large a share of the joint product of capital and labor. (This of course is true, and true beyond the slightest doubt, in the case of certain aggregations of capital throughout the country, but is the exceedingly rare exception and not the rule.) Now, if the reward which capital is receiving is so small that if all of it went to the working people there would only be an increase of 60 cents to the head of each family, we certainly cannot look in this direction for much greater prosperity to the working man.

I have felt sure, both from my personal practical observation, and from everything that I can read on the subject, that the only true hope for an increase in prosperity to the working people lies in an increase in the productivity of every working man, throughout the country. Whether this increase comes through greater personal efficiency, through a better order of co-operation, through the introduction of labor saving machinery, or from whatever source, it is to the increase of productivity of the whole mass of our people that the working people must look for an increase in their prosperity.

This I conceive to be at the root of the whole labor problem, and it seems to me that it is of the very first importance that the laboring people of the country should be brought to understand this fundamental fact. They are now—through labor leaders, through the press, through public opinion—taught to believe that there is something radically wrong with the division of the surplus earnings, and that if they only got their fair share of the joint product of capital and labor, everything in the world would be *couleur de rose* for them.

Now, as to profit sharing. If profit sharing would result in so stimulating the workmen who come under it that each one would very materially increase his daily output, say double his productivity, then I should look to profit sharing as the cure for the present troubles. My judgment and observation and study of men leads me to the conclusion, however, that profit sharing, while it would induce workmen to become slightly more productive, would not have the effect of greatly increasing the average output of the individual. This has been the history of practically all profit sharing institutions up to date. It has *not* greatly stimulated the output of the individual.

And the fundamental reason for this lies in the fact that the human animal is so constituted that he looks upon his own immediate individual welfare and happiness and ease and comfort as of vastly more importance than the welfare of his fellow beings. The only way to get a large output from the individual is to let him have, in plain sight and in the immediate future, a personal reward to *him* which shall be proportional in a way to the exertions and endeavor which he puts forth; so that the profit which the men receive under profit sharing, and which comes to them only at the end of the year, or say every six months, is not a sufficient stimulus to affect them materially in their every day work. This reward is too remote.

I have seen this fact illustrated in so many different ways that to me it has come to be an absolute certainty. The average workman, for example, cannot look forward for more than three weeks to a month for a reward. His reward must come to him at shorter intervals even than this, if he is to be stimulated to greater endeavor. As the character of the individual becomes less formed and weaker, this period must be made shorter and shorter. In my book on "Shop Management," I have referred to the case of a lot of girls who were inspecting bicycle balls. (See pages 85-91, Harper edition). We found distinctly that unless these girls were informed every half hour as to whether they were keeping up properly with their work, they would become entirely indifferent and fall away behind; not just lapse off a little, but they would completely collapse in most cases. This of course is at the extreme lower limit in this respect, but in principle this is practically true of all laboring people.

It is for this reason that the contract system, even, does not in any way compare with the scheme of daily giving a carefully measured task to each workman. To get much of any large return from working men, you must give a short task, to the end of which the workman can look with ease, and against which he can measure himself throughout every hour in the day.

And you *cannot do both;* that is, give the workman an extra large reward day by day, and then also give him a large share of the profits at the end of the year. Let us therefore use the total profit which the workman is to receive in the way which will most increase his productivity.

Now, under scientific management we deliberately plan to increase the workman's wages, or his profit, to the extent of from 35 to 100 per cent each year. By giving him this extra profit day by day, as a reward for accomplishing the tasks laid before him, instead of giving it to him at the end of the year, and also by giving him the help and co-operation of the many men who are working jointly with him on the management side, it is possible on an average to more than double the output of each working man. If the same profit, that is, a profit of from 30 to 100 per cent on his wages, were offered to the working man through the profit sharing scheme and given to him at the end of the year in the form of dividends, my judgment and observation is that it would not increase his productivity to the extent of 10 per cent. And that is my main reason for not favoring the profit sharing scheme. I am exceedingly desirous that the condition of the working man should be bettered. In fact, I am devoting my whole life to this cause. But I am profoundly convinced that the road towards prosperity does not lie in any better scheme for dividing the joint product of capital and labor than those which now exist, but that it does lie in a great number of schemes for greatly increasing the productivity of the average working man, so that my whole time and attention is given to the promotion of schemes which have this for their main object.

Yours very sincerely,

P. S. One more thought in this matter. The only way to make the world happier in a material way is to increase the riches of the world, that is, the material things which are useful to man; and all of these come from two sources only—from what is produced by the earth, or comes up out of the ground, and what is produced by man. An important fact to bear in mind is that more than nineteen-twentieths of all the wealth produced in the world is consumed by the poor people, and not by what are called rich people.

Any increase, therefore, in productivity of the individual simply increases the wealth of the world to that extent, and nineteen-twentieths of this increase goes straight to the poor people.

F. W. T.

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## PERSONAL HISTORY

Some Interesting Facts and Comments About His Early Training and Later Pastimes, by the Founder of Scientific Management.

A Personal Letter.

December 2, 1910.

Mr. Morris L. Cooke,
Boston, Mass.

My dear Mr. Cooke:—

In answer to your letter asking for facts in my personal history, I can hardly think of any with which you are not already familiar.

The two years of school in France and Germany, then a year and a half travel in Italy, Switzerland, Norway, England, France, Germany, Austria, etc., (all of which I disapprove for a young boy), then a return to the healthy out-of-door life of Germantown, than which I believe there is nothing finer in the world, in which sport is the leading idea, with education a long way back, second. Then two years of really very hard study, coupled with athletics, at Exeter, and what I look back upon as perhaps the very best experience of my early life, namely, the very severe Exeter discipline, in which no excuse was taken for any delinquency whatever, and in which every boy had to toe the mark in all respects.

At that time one half of the scholars at Exeter were dropped each year (they have again returned to the old Exeter idea, in which one quarter of the boys were dropped). It was the wrong side of the Exeter training, however, which ruined my eyes and left me no other alternative than working as a workman for the four years following 1874. At that time the great ambition of all boys at Exeter was to be at the head of the class in studies, and the competition was so severe that all of those who were not very brilliant had to work away late into the night in order to get there. It was this competition that broke my eyes down, and it should be also noted that the three other men who led the class before I did also broke down and had to leave Exeter, on account of poor health.

The very best training I had was in the early years of apprenticeship in the pattern shop, when I was under a workman of extraordinary ability, coupled with fine character. I there learned appreciation, respect and admiration for the everyday working mechanic.

Throughout my apprenticeship, of course, I had my eye on the bad industrial conditions which prevailed at the time, and gave a good deal of time and thought to some possible remedy for them. It was this that led me to go to a very much larger company, the Midvale Steel Works, in 1878. I think you know my whole history there; starting from a laborer, getting first into the time office, then back on to the machine as gang boss, etc., etc. Throughout my early days at Midvale I found myself very much short of a scientific education, and began by taking a home study course in mathematics and physics, which was given by the scientific professors at Harvard University. After getting all that I could by correspondence in this way, I then went to the professors at Stevens Institute, and asked them for proper text books, etc., and this started my home study course at Stevens.

About two years and a half after this time, namely, in June, 1883, I graduated as M. E. from Stevens, without however, having been there except for the purpose of passing all of the entrance examinations and finally one after another of the examinations required throughout the course.

You will realize that my time was greatly shortened in getting through Stevens from the fact that I was able to pass in languages—French and German—and in history, etc., right off at the start, owing to my experience abroad and to general reading, etc. So that this left me much less actual work to do than the other boys, and enabled me to get through in two years and a half, while I was at the same time carrying on my duties as foreman, master mechanic, chief draftsman, and chief engineer, successively, at Midvale.

You will probably realize that with me investigation, or rather invention, is a mental dissipation, that it is a very great amusement, rather than a labor, and that if I followed my personal inclinations I would be very likely to give the greater part of my time to this sort of thing. I realize, however, that no man has the right to do very much of this kind of work. This is of course especially true when you are doing it with other people's money, and all through my engineering life I had to keep my conscience in very active service to prevent me from devoting too much time to this end of the business, and not enough to the less interesting, but vital, end of every day management and economy, etc.

No one knows better than you that all the theories, fine or otherwise, which we have evolved as to the principles of scientific management, etc., have come after the fact and not before. Neither I nor any man of our group who has been chiefly instrumental in developing scientific management did so as the result of any preconceived theory. We first evolved the remedy for some existing trouble, and later found out what the theory was that was back of the trouble; and I am not quite sure that some of our group fully understand the weight of this theory, even now.

One of the reasons why I am giving a lot of my time and thought to the growing of grass is that it is an innocent outlet to my tendency to dissipation in the speculative field, in which no one is hurt except myself. Any money that I choose to put in it, or any time, is at my own expense, and even if no results follow no company is hurt. In properly sizing up myself, I believe that the only strong quality which I have is the ability to wait for any length of time, and to keep on working, whether results come or not. This I think is the result of years of habit. I believe that I used to be excessively impatient for immediate results in everything that I went into.

In some grass experiments which you speak of, what I am trying to do is to be able to tell any man in any part of the United States how he can manufacture soil out of raw materials which are purchasable on the market, and which can be reduplicated in any part of the country, rather than to try to tell a man to take some native soil right around him and grow grass in it.

It is absolutely impossible to describe a soil which is in existence so that a man can reduplicate it. You must build up the soil synthetically in order to be able to describe it. And these experiments are chiefly devoted to finding a synthetically built soil which will grow grass better than any soil has in the past. I think I have already reached this, and will far exceed anything that has ever been done in the past, before the experiments are through.

In addition to this, another experiment is going on, which may prove of great value or not, namely, the idea of handing up from a reservoir of water underground the necessary food in solution and the needed water supply to the roots of the plant, so that even in a drought or in the hottest of our Philadelphia summers, grass will stay green all the time, and flourish, where now even with the heaviest of artificial watering it cannot get through some of our summers.

You realize, of course, that in these grass experiments I am experimenting only with the most delicate and difficult of the finer varieties of grass; such grasses as are fit for putting greens, and which it is almost impossible to grow at all under any circumstances in the climate of Philadelphia.

Another part of the experiments in grasses is that in the past, particularly the finer grass seeds, there was no known way of germinating with uniform success. In my experiments I have found a way to germinate properly four to five times as many, at least, as could be done under the old conditions; namely, I manufacture an artificial soil in which the seeds are germinated, and treat the seeds throughout the germinating period in a definite scientific way.

The grass growing problem is really a very large one when it is treated from a scientific standpoint, and I find it an intensely interesting one. I have already made probably 800 or 900 experiments, and expect to make a great many more. I have succeeded in getting the Agricultural Department at Washington very much interested, and they are going to cooperate with me to a very considerable extent. But one of the first things that I found out was that grass needs air all the time at its roots; and it needs air even more than it does water and nourishment. If you exclude the air from the roots in summer time for five days, you will entirely kill the tender varieties of grass, whereas it will do without water for a long time, and revive; and also without nourishment for a good while.

A rather spectacular part of my experiment is that I have succeeded in growing a grass which was planted in the fall, in the month of November, and which went from the first of June till the first of September without having a drop of rain or other artificial moisture come to it from above. A glass cover was put over it to keep the rain water off, and it received its water supply from the water reservoir below, through the lifting sands which soaked the water up from the reservoir and passed it on up to the roots.

We experimented with lifting sands from all parts of the country, and finally succeeded in finding sand of a particular grain composition, which will lift water as high as 48 inches from a water reservoir below, and hand it over to the grass roots. Some ordinary sands will lift water only half an inch, some not at all, others all the way between this and 48 inches, depending upon the grain composition of the sands.

The years which Mrs. Taylor and I spent away from Philadelphia were at the time very trying ones, as we both lived in very narrow quarters, in a single room most of the time, and yet we both look upon this period as the most developing perhaps of our lives. We were obliged to mingle with people from all parts of the country and as a result we found the finest kind of men and women living in all ranks of society, and in the smallest and most out of the way places. We both value this experience, because of the enlarged sympathies which it gave us for our own kind.

You of course know yourself the nature of the work involved in systematizing. It involves a mingling of war and peace, of hard blows and tact, which gives one rather a trying life, and I can assure you that this was no less true in the past than it is now. It was a life full of disappointments in many respects and yet full of great satisfaction whenever results were accomplished.

Yours very sincerely,

Dictated by F. W. T. but not revised.

## GOVERNMENT EFFICIENCY[1]

By Frederick Winslow Taylor.

It may be said, on the whole, that the quality of the work done by government employes is good, not superlatively so, but on the whole good.

For example, while we have not been leaders in the development of our army and navy equipment, and in the development of army and navy tactics, etc., still we have followed closely in the wake of the leaders. For example, we did not invent the Dreadnought, nor the torpedo boat, nor the dirigible torpedo, nor were we the first to make high power steel guns, but we have been quick in following after the best of the foreign nations in choosing our equipment.

When, however, we come to consider the quantity of service which is rendered by our government employes, we find quite the reverse. It can in fact be safely said that the average government employe does not do more than one-third to one-half of a proper day's work. The reason for this contradictory state of affairs is not far to seek. The quality of the service must be good, because on the whole our people are accustomed to seeing and possessing the best equipment. We are a nation who believe in first-class things, and the quality of the results produced by government employes can be seen and appreciated by the people.

From this fact has grown up the feeling almost universal among government employes, that to make a blunder is fatal, or at least very serious, because a mistake or a blunder will be recorded against the employe and remembered throughout his career. However efficient and energetic an employe may have been in doing his work, this will not atone for his having made a blunder. Consequently, splendid positive constructive results, brought about by a government employe, count for less than freedom from errors. In a very great number of cases the government employe fully realizes that in case he does a particularly original or especially efficient piece of work for the government, those who are over him will insist that the credit for his accomplishment shall be theirs, and in many cases instead of commending and rewarding the man, jealousy on their part leads them to persecute him. Thus "play safe" is the rule in the government service, even if you accomplish little or nothing. Yet nothing in industrial life is more true than that the man who never makes mistakes never accomplishes anything.

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[1] A hitherto unpublished article written probably in 1911.

On the other hand, when it comes to the quantity of work done by each employe, the public (that is, the whole people) has as yet had no definite standard for measuring the work of its public servants. And in fact, in a general way it may be said that the people of our country realize that most government employes are inefficient (exactly how greatly inefficient they do not know), and that they have come to look upon this as perhaps the normal state of affairs. We would all like to have the highest possible standard of efficiency for our public servants, but a hundred years of experience have shown us that they are almost universally inefficient, and we have come to look upon this condition as irremediable.

There have been, indeed, fundamental reasons why government employes should be inefficient, instead of efficient. Throughout civil life, 19 out of 20 employes realize that in order to succeed they must render a quality and quantity of service which will enable them to compete with a large number of other men who are at all times ready to take their positions in case they fail to make good. Thus they fully realize that it is only through their own personal accomplishment, through each day doing a big day's work and doing it right, that they can hold their jobs and have the hope of advancement. In government service, however, it has been almost universal that the employe has received his position mainly through the influence which he has been able to bring to bear upon the men at the top. The employment has been given as a reward for political services, and the men have held their jobs more through political pull and influence than through merit. In civil life almost every employe feels that the permanent tenure of his job, as well as his advancement, depends upon his ability to continually render full and efficient service to his employer. Few of the government employes (even those under civil service rules) feel any fear of losing their jobs on account of not doing a full day's work. They almost all realize the importance of not making any serious blunder, but providing they make no serious mistakes they feel that they can do only a fraction of a day's work, without danger of losing their jobs.

Even in spite of civil service examinations, this still remains substantially true, that certainly the greater number of government employes look to influence to keep their jobs rather than to their own merit. Even when the government employes have ceased their own political activity in the direction of getting votes for their party, and doing similar party work, still they realize that political pull is more important for their success than turning out a large day's work.

The government as an employer is looked upon in a totally different light from the private employer. Government employ is looked upon as a crib at which vast numbers of men are to be fed. The Congressman in whose districts government work goes on; the labor leaders who claim to be able to deliver the labor vote; large numbers of workmen, and in many cases the government officials—even those high in rank—unite in adopting the view that the principal function of government employment is to provide work for their henchmen, their friends, and their political allies. By many of these men government employment is viewed almost entirely from this standpoint, so that the more men they can get in the government employ and the higher the wages that these men are paid, the better they are satisfied. All hands, however, realize that the American people will not tolerate a sloppy quality of work, so that in spite of the fundamental lack of interest in the results obtained, a fairly good quality of work is insisted upon. This mental attitude still represents the survival of the old "spoils system" in which practically the whole people acquiesce, in the conviction that "to the victor belong the spoils." This mental attitude on the part of the great majority of those connected with government work represents the largest obstacle to government efficiency. And the principal problem before any administration which attempts to obtain government efficiency will be that of changing this mental attitude, shared by practically all government employes.

In the past there has been very little inducement for those superintendents and managers who believe in a large and full day's work to go into government employ, and with very rare exceptions every man who has undertaken to bring about efficiency in large numbers of public employes has failed and has ended by deeply regretting that he ever had anything to do with the whole problem of getting a fair day's work out of government employes. Even under what may be looked upon as a reform administration, that for example of President Roosevelt, we have the notable instance of Mr. Stillings, who went into the government Printing Office with President Roosevelt's entire approval, and who made great changes, practically all tending toward increased efficiency. He dismissed hundreds of incompetents, hundreds of loafers, from the Printing Office and was in a fair way, if time had been given him, to make a reasonably efficient establishment out of the Printing Bureau, which had been nothing less than a public scandal. The discharged employes, the labor leaders, and many politicians in Washington (some in Congress), and even some high up in the Senate, however, united in opposing the good work of Stillings and, during the campaign for the election of Mr. Taft for the Presidency, they took advantage of certain blunders which Mr. Stillings had made to drive him out of the government employ. And this in spite of the fact that the errors and mistakes which he had made were not equal to one-thousandth part of the good which he had accomplished. It can be safely said that Stillings' dismissal was the direct result of the supposed political necessity of electing Mr. Taft to office. Stillings was sacrificed to the good of this cause. It must be understood, however, that Mr. Taft had nothing whatever to do with Mr. Stillings' dismissal, and it is doubtful even whether he was aware of it. At any rate, this is not an arraignment of any individual but of the supposed necessities of our system.

Now, with object lessons of this sort before them, there is very little inducement for strong and earnest men to undertake the type of fight which is necessary in order to secure a fair day's work from government employes. The government official who attempts to insist upon a full, proper day's work from the employes who are under him, goes at this undertaking with the certainty that he will have the bitter enmity of the public officials high and low, and that whatever promises he may have received from those who are over him, he is likely to share the fate of Mr. Stillings, and many others who have made this attempt. Any attempt at efficiency is looked upon by the place holders and their backers as an assault upon their personal rights, and is fought by all parties with bitterness. Man after man who has come into the high places in government employ, and who has fully realized the gross inefficiency of government employes and been possessed with an earnest desire to reform, has weakened when he realized the tremendous uphill fight ahead of him, with the prospect that when the next Congressional or national election came he would be made a sacrifice for the necessity of obtaining votes. This has led him to give up any great effort towards increased efficiency, and to turn his energies into other channels.

Government efficiency will never be brought about until the prevailing mental attitude of government employes has been radically changed; and the great problem is how this great change is to be brought about. In facing this problem, the first fact which must be approached is that a great mental revolution of this sort will of necessity demand a large amount of time. It is not a question of producing physical changes, but rather of working a great mental revolution in large numbers of men, and any such change demands time, and a large amount of time.

It is absolutely useless to attack this system until our Chief Executive Officer shall be deadly in earnest in this attainment of efficiency, and I think it can be said that no President, up to Mr. Taft's administration, has had government efficiency as a serious problem before him. No government employe who looks back at what has happened in the past, however high up he may be, will in the future want to tackle this great problem of efficiency without the backing of the President of the United States, and without the certainty that the President of the United States will guard all those who are engaged in the earnest effort to increase government efficiency from political attacks, and that he will place government efficiency above the getting of votes, either at the time of a Congressional or national election. I believe this is the very first requirement in the attainment of efficiency, that the President shall place it above and beyond politics.

In the case of my personal friends, who have been asked to assist in obtaining government efficiency under Mr. Taft's administration, knowing the treatment that was meted out to Mr. Stillings, for example, they have invariably undertaken this service for the government with very great reluctance, even under the administration of Mr. Taft, whom we all believe to be earnestly seeking for government efficiency. They have all been afraid that when the time came for getting votes, that such pressure would be brought upon the administration through the labor leaders, through the political leaders, through all government employes, and through Congressmen, Senators, and even some members of the Cabinet, that even to a man of Mr. Taft's sterling qualities it might appear to be of less importance to sacrifice the man who was engaged in promoting efficiency rather than to lose votes at the election.

First, then, be sure that the President of the United States is solidly behind this government. Not only this, but it is almost a necessity that the President should have some advisor close to him in whom he will have complete confidence as far as this efficiency problem is concerned. There is no question that Mr. Taft earnestly desires economy and efficiency in government administration, and yet no fixed or settled policy has been followed during his administration. So those men who are working for efficiency are constantly left in doubt as to whether they will ultimately receive the backing of the President or not. For example, in the War Department, under General Crozier, the Chief of Ordnance, the principles of scientific management have been adopted as the standard, and for two years and a half to three years this Department has been working with great energy and success in introducing these principles. During this same period, however, the Navy Department have been carefully hunting down every element of scientific management which was installed in the Navy Yards, and completely wiping it off the slate. And both of these occurrences have gone on with the knowledge of the President. This can be accounted for only by the fact that the President himself has no fixed or settled policy as to the means to be taken in accomplishing efficiency. And why should he, when he has in his Cabinet not a single man with whom industrial efficiency has been a life study? It would seem that under any President who really wants efficiency, one cabinet officer should be chosen whose chief interest will be that of obtaining governmental efficiency, and who will be able to properly post the President as to the steps to be taken and unify the action of the administration throughout all of the governmental departments.

The greatest emphasis should be laid upon the fact that, in order to obtain results, it is necessary to begin at the top, with the thorough co-operation of the President and his Cabinet. And, bearing in mind that four years is a short time in which to effect changes which are well worth while, it seems almost a necessity to begin work in the early part of a Presidential administration; that is, unless the President is to be re-elected, because history indicates the fact that a change of administration almost always marks a very material change in the governmental policies, even though the two succeeding Presidents may belong to the same party. History shows that too frequently the President himself, and in a large number of cases the Cabinet officers, think it necessary for their own personal success that they should openly and avowedly greatly modify the policy of their predecessors. In order to brand the achievements during their own administration with their own names, they find it necessary to discredit the accomplishment of those who went before them.

Having then laid the proper foundation, through obtaining the backing of the Chief Executive and his officers, the important question is, what steps shall be taken to produce efficiency. Our answer to this is that, in the government departments, one should follow the same procedure as is followed in the organization of industrial companies. Under the older systems of management which are in common use, it has been necessary in order to obtain the best results in management, to secure the services of some one or more men of very exceptional, in fact extraordinary, ability; and the personality of these uncommon men has been relied upon largely to bring about results. Such men through their personal knowledge, through that knowledge and special ability which they carry in their own heads and which dies with them, and through their personal magnetism and energy, control and guide the men under them. Under the older system of management, in which the problem of obtaining greater efficiency is put up directly to the men, the function of the manager lay chiefly in persuading men largely through personal influence, to do better for their employer than they had in the past. Under scientific management, fortunately for the possibility of progress in governmental employ, the personality of the few men or the man at the top is far less important than under the older management. This necessity of securing a very-high-class man has in the past made any great progress almost impossible under government employ, because the highest class civilians have greatly hesitated to accept government employment, owing to the fact that politics have played in the past such a large part. They recognized that the difficulty of playing the political game in addition to their own specialty of bringing about greater efficiency was too large an undertaking, and have almost invariably preferred private to public employment. So the impossibility of getting these great leaders or captains of industry to enter government employ, in itself made it impossible to achieve any great amount of efficiency.

The process of building up an efficient management under the principles of scientific management is radically different from the older type. Under scientific management, personal influence counts for far less than the other elements. The scientific study of what should constitute a proper day's work for each government employe becomes the element of perhaps the greatest importance, and this study can be made by men of very ordinary calibre. It calls for honesty on the part of the time student, and continued hard work, but not the extraordinary qualities demanded of the old type "captain of industry." It places the development of the science of doing each kind of work far above any man or men, and makes it possible for a number of ordinary men when co-operating with the aid of science, to far outstrip the individual leaders of the past.

This study of the duties of each individual government employee and of the proper time required to perform those duties, evidently involves a very large amount of continuous, plodding work. Fortunately, however, the results from this analysis of duties and of the time required to perform those duties, begin to show almost immediately, and present the foundation for obtaining important economies in the government service. When it is shown, for example, that the clerical work to be performed by a man in a given position in the government can be done in an hour and a half a day, whereas he now takes the whole day, this fact alone points the road towards economy. To use the expression in common use, in scientific management, each employe is given his daily task to perform, and the determination of this daily task really lays the foundation for government efficiency.

This system has a very great advantage over the older system, in that many hundreds of men can work at the same time in widely scattered locations in laying this foundation for efficiency; whereas, under the old plan, where personal influence counted, the work of the usual man was of necessity confined to a small group of men under him. Without doubt a central planning department should be established, in which the governmental standards for a proper day's work, etc., should be recorded and distributed to the local planning departments.

Under the older system of management, it has been usual to start at an entirely different point, that is, by introducing a system of cost records, showing the expense of performing each class of work, etc., and acting on this idea President Taft has established his "Commission on Economy and Efficiency," of which Dr. Cleveland is the head. I do not wish in any way to deprecate or belittle the use of a system of cost records of this sort. The establishing of a budget for the United States Government in a way similar to that which is made out for the English Government should be an immense help both to the executive departments and to Congress in carrying on the governmental work; but what I want to emphasize is that this leads only in the most indirect way to efficiency. It does not produce efficiency. An accounting system at the best is a signboard which points out inefficiency. It is a hand, indicating "This is an especially inefficient spot." Now we all of us know that practically all of the activities of the United States government are carried on in an inefficient way, that is, as far as quantity of work is concerned, not in quality; so that in the government work at least, we now need no accounting system to point to the fact that the work is inefficient.

On the other hand, as the work grows more and more efficient, then the accounting system becomes more desirable to point out and equalize inequalities between different departments and in different localities.

My advice, therefore, is to begin by setting up the great standards of efficiency to which the various men in government employ should rise. With these tasks established for each position, it becomes possible, automatically and rapidly to weed out the drones and the inefficient men, or change men from positions for which they are not well suited to other positions for which they are well adapted. The discharge of an employe or his promotion or his change of position is no longer, under scientific management, a question of opinion of some man who is over him, it is a question of recorded fact. The man is unable to accomplish his daily task, and therefore must make room for some man who is.

This system, then, in this way makes for very rapid progress. It is clear, however, that in the application of this new test for filling and holding governmental positions, the old idea of influence, pull and friendship must entirely disappear, and it will be useless for any administration to go after real efficiency in government service unless they are willing to disregard absolutely this political influence which even now plays the most important part in government service. The moment those at the top cease giving attention to the backing and to the pull of the government employe, that moment will the employe himself start to change his mental attitude towards his own work, and he will realize that his success must in the future depend upon his own efforts, and not on what some one else can do for him.

The Civil Service examinations and rules have done an immense amount in keeping men out of the government service who were utterly unfitted for their jobs. In no sense do I advocate any relaxing of the Civil Service requirements. It is very unfortunate, however, that no Civil Service examination has been devised which will indicate whether the applicant has the moral qualities required for his job, whether he has integrity, grit, energy, perseverance, etc. Of necessity the Civil Service rules are limited, one may say, to the mental qualifications. The need, therefore, in government service is some way by which the other much needed qualities can be recognized and have their proper weight in the selection and in the retention of a candidate. It should at least be possible at all times for the government to discharge peremptorily a man who lacks energy, determination, and the moral qualities necessary to obtain results in his particular job.

The moment political influence ceases, and when those high up in government office or employ cease to consider in the least the political qualifications of government employes, it will become comparatively easy to promote men who show especially fine qualities other than intellectual, and in the same way get rid of those who lack these qualities. Emphasis, however, must be laid upon the fact that there is no hope whatever of obtaining any great increase in efficiency unless the managing heads of the various departments and the important leading men who are under them look upon their government positions practically as their life's work. If they contemplate the probability of going out of government employ every four years and making room for a man of some other political complexion, or for some one who has rendered the incoming administration important political service, then no great or lasting progress can be made in government efficiency. We have before us two object lessons which illustrate, in a very remarkable way, the necessity for permanency in government positions. These object lessons are presented by the two most important manufacturing or engineering departments of the government, namely, the Ordnance Department of the Army, which controls the manufacture of the guns, ammunition, munitions of war, and supplies of all kinds for the Army; and the Navy Yards, which perform a similar function for the Navy.

At the head of each of these Departments we have, individually, an unusually fine set of men. It should be made perfectly clear to the public that, as a class, our naval officers represent a magnificent body of picked men, who are devoted to the government service, who are self-sacrificing, and who in their duties at sea are an uncommonly efficient and hard-working set of men. Too large a part of our people look upon our naval officers as rather ornamental men who fill easy berths. This is far from the truth. It would be difficult to find a more devoted, hard-working and upright set of men than compose a great body of the officers of our Navy. The writer has been fortunate in having been placed in close, intimate contact with numbers of these men for many years, because he was engaged in the Midvale Steel Works, in the Bethlehem Steel Works and Cramps Ship Yard, in the manufacture of the materials from which our big guns, armor plate, ships and the machinery in them, were manufactured, and in his whole personal experience he never met a single naval officer with whom there was even the slightest suspicion of corruption or in fact of anything but the highest motives. The same is equally true of our army officers. The writer has had more to do with the officers in the manufacturing department of the government, that is, the Ordnance Department, than with the line officers, but with all of these men his experience has been the same as with naval offiers, namely, that they represent the highest type of American citizens. The criticism, then, which is being made of the Navy, as well as against the Army, is one of system and methods, and not of the personnel.

The scheme of management in all of our navy yards has involved bringing on shore for from one to three years all naval officers, and placing them in command of the navy yards as a whole; also of placing the detailed management of each of the shops, and even the subdivision of the shops under naval officers, who come directly from sea duty. It is no reflection on these naval officers to say that these men, who are admirably trained and suited to their work on board battle ships, are utterly untrained and unfit to manage the industrial work which goes on in the navy yard. Any one of these naval officers would recognize the complete unfitness of, we will say, the best manager of a large machine shop to take command of a battle ship, and yet without hesitation these men, who have been trained to the command of battle ships, assume all of the responsibilities of the manager of a machine shop. Thus, it is perfectly clear that for success in managing any one of the large manufacturing departments of the navy yards, the man must make it his life's work, and must have been especially educated and trained to it, just as he should be especially educated and trained to the management of the battle ship.

In many respects, also, the training which the naval officers receive at sea largely unfits them to be at the head of an industrial establishment. The kind of discipline which must be maintained on shipboard, the methods which must be used there in directing the 800 or 1,000 men on a battle ship, are almost directly opposed to the methods which must be used in the management of the men of a machine shop. Their habits of mind and the whole education which they have received in handling men at sea actually unfits them for handling men in civilian life, and this makes it almost impossible for them to learn very much about the management of a shop even in the two or three years during which they are detailed to this work. For this reason, while our navy yards have been in the past officered and commanded both in gross and in detail, nominally by naval officers, they have really been managed and run by the civilian foremen and quartermen, etc., who in our navy yards are distinctly the cheap second, third and fourth class men. And it must be said that it is next to impossible to get a really first-class foreman to accept service under naval officers in our navy yards.

Again, the fact should be emphasized that this is no reflection upon the individual character of our naval officers, but it marks the great, and, I suppose, essential difference in the types of management necessary for success in civilian life and in military life.

It may be said, then, of these naval officers, that they come to their jobs in the navy yards knowing practically nothing about their work, and that they leave their jobs in nine cases out of ten, after two or three years of service, with almost no knowledge of industrial work. Shore duty for men is an incident. Their real life's work and their ambitions and hopes for success, lie at sea; and very properly they look upon their shore duty in most cases chiefly as their opportunity to make the acquaintance of their families and get in touch with the life of the country. They themselves realize the impossibility of becoming skillful in more than one profession, and practically do not make the attempt.

These cheap civilians who are really in command of our navy yards, unfortunately, have no interest whatever in promoting efficiency. In fact, they join with the workmen in the yard, and are universally backed up in this by the labor unions, in trying to make employment in the yards for the largest possible number of workmen, and in many, if not most cases, they assist the workmen in seeing to it that each man does a small day's work, instead of a large day's work, thus making room for more employes.

The Ordnance Department of the Army, on the other hand, presents a totally different object lesson. In this Department, the officers are selected from the line of the Army by competitive examinations, and they enter this Department expecting to devote their lives to the industrial problems rather than to the military problems; that is, to the scientific study of the design and manufacture of the implements of war, which becomes mainly an industrial problem. Thus the mental attitude of these officers differs entirely from that of the navy officers. Their ambitions lie towards promoting efficiency in manufacture. The present organization of this Department offers an ideal opportunity for the development and selection of men well suited to their work. At the end of every three or four years (?) the young officers are obliged to go back to the line of the Army for a year's work, and unless they have made good in their work as manufacturers or designers they are not again taken into the Ordnance Department. On the other hand, if they themselves find that they are unfitted to work of this character, they can voluntarily return to the line. This insures the gradual selection of men especially picked for the manufacturing duties, and this primarily accounts for the fact that the work of the Ordnance Department under the Secretary of War, with General Crozier at its head, represents the only case in which government shops and government employes are able to successfully compete, as far as the cost of manufacture as well as accuracy and finish of the work is concerned, with corresponding manufacturing companies in civil life.

It should be emphasized again that the officers of the Army are of the same general calibre of men as those of the Navy, so that the utter failure of the Navy, the fact that the navy yards become a byword and a laughing stock in industrial life, is not due to a difference in the naval officer from the army officer, but is due to the difference of the systems in vogue in the two, and until we have permanent managers in our navy yards there is no hope whatever of any great increase in efficiency. This again illustrates the fact that you must lay your foundation by beginning with the men at the top, not with those at the bottom.

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# THE PRINCIPLES OF SCIENTIFIC MANAGEMENT[1]

By Frederick Winslow Taylor

By far the most important fact which faces the industries of our country, the industries, in fact, of the civilized world, is that not only the average worker, but nineteen out of twenty workmen throughout the civilized world firmly believe that it is for their best interests to go slow instead of to go fast. They firmly believe that it is for their interest to give as little work in return for the money that they get as is practical. The reasons for this belief are two-fold, and I do not believe that the workingmen are to blame for holding these fallacious views.

If you will take any set of workmen in your own town and suggest to those men that it would be a good thing for them in their trade if they were to double their output in the coming year, each man turn out twice as much work and become twice as efficient, they would say, "I do not know anything about other people's trades; what you are saying about increasing efficiency being a good thing may be good for other trades, but I know that the only result if you come to our trade would be that half of us would be out of a job before the year was out." That to the average workman is an axiom, it is not a matter subject to debate at all. And even among the average business men of this country that opinion is almost universal. They firmly believe that that would be the result of a great increase in efficiency, and yet directly the opposite is true.

### The Effect of Labor-saving Devices

Whenever any labor-saving device of any kind has been introduced into any trade—go back into the history of any trade and see it—even though that labor-saving device may turn out ten, twenty, thirty times that output that was originally turned out by men in that trade, the result has universally been to make work for more men in that trade, not work for less men.

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[1] An abstract of an address given by the late Dr. Taylor before the Cleveland Advertising Club, March 3, 1915, two weeks prior to his death. It was repeated the following day at Youngstown, Ohio, and this presentation was Dr. Taylor's last public appearance.

Let me give you one illustration. Let us take one of the staple businesses, the cotton industry. About 1840 the power loom succeeded the old hand loom in the cotton industry. It was invented many years before, somewhere about 1780 or 1790, but it came in very slowly. About 1840 the weavers of Manchester, England, saw that the power loom was coming, and they knew it would turn out three times the yardage of cloth in a day that the hand loom turned out. And what did they do, these five thousand weavers of Manchester, England, who saw starvation staring them in the face? They broke into the establishments into which those machines were being introduced, they smashed them, they did everything possible to stop the introduction of the power loom. And the same result followed that follows every attempt to interfere with the introduction of any labor-saving device, if it is really a labor-saving device. Instead of stopping the introduction of the power loom, their opposition apparently accelerated it, just as opposition to scientific management all over the country, bitter labor opposition to-day, is accelerating the introduction of it instead of retarding it. History repeats itself in that respect. The power loom came right straight along.

And let us see the result in Manchester. Just what follows in every industry when any labor-saving device is introduced. Less than a century has gone by since 1840. The population of England in that time has not more than doubled. Each man in the cotton industry in Manchester, England, now turns out, at a restricted estimate ten yards of cloth for every yard of cloth that was turned out in 1840. In 1840 there were 5,000 weavers in Manchester. Now there are 265,000. Has that thrown men out of work? Has the introduction of labor-saving machinery, which has multiplied the output per man by ten-fold, thrown men out of work?

What is the real meaning of this? All that you have to do is to bring wealth into this world and the world uses it. That is the real meaning. The meaning is that wherein 1840 cotton goods were a luxury to be worn only by rich people when they were hardly ever seen on the street, now every man, woman and child all over the world wears cotton goods as a daily necessity.

Nineteen-twentieths of the real wealth of this world is used by the poor people, and not the rich, so that the workingman who sets out as a steady principle to restrict output is merely robbing his own kind. That group of manufacturers which adopts as a permanent principle restriction of output, in order to hold up prices, is robbing the world. The one great thing that marks the improvement of this world is measured by the enormous increase in output of the individuals in this world. There is fully twenty times the output per man now that there was three hundred years ago. That marks the increase in the real wealth of the world; that marks the increase of the happiness of the world, that gives us the opportunity for shorter hours, for better education, for amusement, for art, for music, for everything that is worth while in this world—goes right straight back to this increase in the output of the individual. The workingmen of today live better than the king did three hundred years ago. From what does the progress the world has made come? Simply from the increase in the output of the individual all over the world.

### THE DEVELOPMENT OF SOLDIERING

The second reason why the workmen of this country and of Europe deliberately restrict output is a very simple one. They, for this reason, are even less to blame than they are for the other. If, for example, you are manufacturing a pen, let us assume for simplicity that a pen can be made by a single man. Let us say that the workman is turning out ten pens per day, and that he is receiving $2.50 a day for his wages. He has a progressive foreman who is up to date, and that foreman goes to the workman and suggests, "Here, John, you are getting $2.50 a day, and you are turning out ten pens. I would suggest that I pay you 25 cents for making that pen." The man takes the job, and through the help of his foreman, through his own ingenuity, through his increased work, through his interest in his business, through the help of his friends, at the end of the year he finds himself turning out twenty pens instead of ten. He is happy, he is making $5, instead of $2.50 a day. His foreman is happy because, with the same room, with the same men he had before, he has doubled the output of his department, and the manufacturer himself is sometimes happy, but not often. Then someone on the board of directors asks to see the payroll, and he finds that we are paying $5 a day where other similar mechanics are only getting $2.50, and in no uncertain terms he announces that we must stop ruining the labor market. We cannot pay $5 a day when the standard rate of wages is $2.50; how can we hope to compete with surrounding towns? What is the result? Mr. Foreman is sent for, and he is told that he has got to stop ruining the labor market of Cleveland. And the foreman goes back to his workman in sadness, in depression, and tells his workman, "I am sorry, John, but I have got to cut the price down for that pen; I cannot let you earn $5 a day; the board of directors has got on to it, and it is ruining the labor market; you ought to be willing to have the price reduced. You cannot earn more than $3 or $2.75 a day, and I will have to cut your wages so that you will only get $3 a day." John, of necessity accepts the cut, but he sees to it that he never makes enough pens to get another cut.

### CHARACTERISTICS OF THE UNION WORKMAN

There seem to be two divergent opinions about the workmen of this country. One is that a lot of the trade unions' workmen, particularly in this country, have become brutal, have become dominating, careless of any interests but their own, and are a pretty poor lot. And the other opinion which those same trade unionists hold of themselves is that they are pretty close to little gods. Whichever view you may hold of the workingmen of this country, and my personal view of them is that they are a pretty fine lot of fellows, they are just about the same as you and I. But whether you hold the bad opinion or the good opinion, it makes no difference. Whatever the workingmen of this country are or whatever they are not, they are not fools. And all that is necessary is for a workingman to have but one object lesson, like that I have told you, and he soldiers for the rest of his life.

There are a few exceptional employers who treat their workmen differently, but I am talking about the rule of the country. Soldiering is the absolute rule with all workmen who know their business. I am not saying it is for their interest to soldier. You cannot blame them for it. You cannot expect them to be large enough minded men to look at the proper view of the matter. Nor is the man who cuts the wages necessarily to blame. It is simply a misfortune in industry.

### THE DEVELOPMENT OF SCIENTIFIC MANAGEMENT

There has been, until comparatively recently, no scheme promulgated by which the evils of rate cutting could be properly avoided, so soldiering has been the rule.

Now the first step that was taken toward the development of those methods, of those principles, which rightly or wrongly have come to be known under the name of scientific management, the first step that was taken was taken in an earnest endeavor to remedy the evils of soldiering; an earnest endeavor to make it unnecessary for workmen to be hypocritical in this way, to deceive themselves, to deceive their employers, to live day in and day out a life of deceit, forced upon them by conditions—the very first step that was taken toward the development was to overcome that evil. I want to emphasize that, because I wish to emphasize the one great fact relating to scientific management, the greatest factor, namely, that scientific management is no new set of theories that has been tried on by any one at every step. Scientific management at every step has been an evolution, not a theory. In all cases the practice has preceded the theory, not succeeded it. In every case one measure after another has been tried out, until the proper remedy has been found. That series of proper eliminations, that evolution, is what is called scientific management. Every element of it has had to fight its way against the elements that preceded it, and prove itself better or it would not be there to-morrow.

All the men that I know of who are in any way connected with scientific management are ready to abandon any scheme, any theory in favor of anything else that could be found that is better. There is nothing in scientific management that is fixed. There is no one man, or group of men, who has invented scientific management.

What I want to emphasize is that all of the elements of scientific management are an evolution, not an invention. Scientific management is in use in an immense range and variety of industries. Almost every type of industry in this country has scientific management working successfully. I think I can safely say that on the average in those establishments in which scientific management has been introduced, the average workman is turning out double the output he was before. I think that is a conservative statement.

### THE WORKMEN THE CHIEF BENEFICIARIES

Three or four years ago I could have said there were about fifty thousand men working under scientific management, but now I know there are many more. Company after company is coming under it, many of which I know nothing about. Almost universally they are working successfully. This increasing of the output per individual in the trade, results, of course, in cheapening the product; it results, therefore, in larger profit usually to the owners of the business; it results also, in many cases, in a lowering of the selling price, although that has not come to the extent it will later. In the end the public gets the good. Without any question, the large good which so far has come from scientific management has come to the worker. To the workman has come, practically right off as soon as scientific management is introduced, an increase in wages amounting from 33 to 100 per cent, and yet that is not the greatest good that comes to the workmen from scientific management. The great good comes from the fact that, under scientific management, they look upon their employers as the best friends they have in the world; the suspicious watchfulness which characterizes the old type of management, the semi-antagonism, or the complete antagonism between workmen and employers is entirely superseded, and in its place comes genuine friendship between both sides. That is the greatest good that has come under scientific management. As a proof of this in the many businesses in which scientific management has been introduced, I know of not one single strike of workmen working under it after it had been introduced, and only two or three while it was in process of introduction. In this connection I must speak of the fakers, those who have said they can introduce scientific management into a business in six months or a year. That is pure nonsense. There have been many strikes stirred up by that type of man. Not one strike has ever come, and I do not believe ever will come, under scientific management.

### WHAT SCIENTIFIC MANAGEMENT IS

What is scientific management? It is no efficiency device, nor is it any group or collection of efficiency devices. Scientific management is no new scheme for paying men, it is no bonus system, no piece-work system, no premium system of payment; it is no new method of figuring costs. It is no one of the various elements by which it is commonly known, by which people refer to it. It is not time study nor man study. It is not the printing of a ton or two of blanks and unloading them on a company and saying, "There is your system, go ahead and use it." Scientific management does not exist and cannot exist until there has been a complete mental revolution on the part of the workmen working under it, as to their duties toward themselves and toward their employers, and a complete mental revolution in the outlook of the employers, toward their duties, toward themselves, and toward their workmen. And until this great mental change takes place, scientific management does not exist. Do you think you can make a great mental revolution in a large group of workmen in a year, or do you think you can make it in a large group of foremen and superintendents in a year? If you do, you are very much mistaken. All of us hold mighty close to our ideas and principles in life, and we change very slowly toward the new, and very properly too.

Let me give you an idea of what I mean by this change in mental outlook. If you are manufacturing a hammer or a mallet, into the cost of that mallet goes a certain amount of raw materials, a certain amount of wood and metal. If you will take the cost of the raw materials and then add to it that cost which is frequently called by various names—overhead expenses, general expense, indirect expense; that is, the proper share of taxes, insurance, light, heat, salaries of officers and advertising—and you have a sum of money. Subtract that sum from the selling price, and what is left over is called the surplus. It is over this surplus that all of the labor disputes in the past have occurred. The workman naturally wants all he can get. His wages come out of that surplus. The manufacturer wants all he can get in the shape of profits, and it is from the division of this surplus that all the labor disputes have come in the past—the equitable division.

The new outlook that comes under scientific management is this: The workmen, after many object lessons, come to see, and the management come to see that this surplus can be made so great, providing both sides will stop their pulling apart, will stop their fighting and will push as hard as they can to get as cheap an output as possible, that there is no occasion to quarrel. Each side can get more than ever before. The acknowledgment of this fact represents a complete mental revolution.

### INTELLIGENT OLD-STYLE MANAGEMENT

There is one more illustration of the new and great change which comes under scientific management. I can make it clearer, perhaps, by contrasting it with what I look upon as the best of the older types of management. If you have a company employing five hundred or a thousand men, you will have in that company perhaps fifteen different trades. The workmen in those trades have learned absolutely all that they know, not from books, not by being taught, but they have learned it traditionally. It has been handed down to them, not even by word of mouth in many cases, but by seeing what other men do. One man stands alongside of another man and imitates him. That is the way the trades are handed down, and my impression is that trades are now picked up just as they were in the Middle Ages.

The manufacturer, the manager, or the foreman who knows his business realizes that his chief function as a manager—I am talking now of the old-fashioned manager—ought to be to get the true initiative of his workman. He wants the initiative of the workman, their hard work, their good will, their ingenuity, their determination to do all they can for the benefit of his firm. If he knows anything about human nature, if he has thought over the problems, he must realize that in order to get the initiative of his workman, in order to modify their soldiering, he must do something more for his men than other employers are doing for their men under similar circumstances. The wise manager, under the old type of management, deliberately sets out to do something better for his workmen than his competitors are doing, better than he himself has ever done before. It takes a good while for the workmen to stop looking for that "nigger in the wood-pile," but if the manager keeps at them long enough he will get the confidence of the men, and when he does workmen of all kinds will respond by giving a great increase in output. When he sets out to do better for his men than other people do for theirs, the workmen respond liberally when that time comes. I refer to this case as being the highest type of management, the case in which the managers deliberately set out to do something better for their workmen than other people are doing, and to give them a special incentive of some kind, to which the workmen respond by giving a share at least of their initiative.

### WHAT SCIENTIFIC MANAGEMENT WILL DO

I am going to try to prove to you that even that type of management has not a ghost of a chance in competition with the principles of scientific management. Why? In the first place, under scientific management, the initiative of the workmen, their hard work, their good-will, their best endeavors are obtained with absolute regularity. There are cases all the time where men will soldier, but they become the exception, as a rule, and they give their true initiative under scientific management. That is the least of the two sources of gain. The greatest source of gain under scientific management comes from the new and almost unheard-of duties and burdens which are voluntarily assumed, not by the workmen, but by the men on the management side. These are the things which make scientific management a success. These new duties, these new burdens undertaken by the management have rightly or wrongly been divided into four groups, and have been called the principles of scientific management.

The first of the great principles of scientific management, the first of the new burdens which are voluntarily undertaken by those on the management side is the deliberate gathering together of the great mass of traditional knowledge which, in the past, has been in the heads of the workmen, recording it, tabulating it, reducing it in most cases to rules, laws, and in many cases to mathematical formulæ, which, with these new laws, are applied to the co-operation of the management to the work of the workmen. This results in an immense increase in the output, we may say, of the two. The gathering in of this great mass of traditional knowledge, which is done by the means of motion study, time study, can be truly called the science.

Let me make a prediction. I have before me the first book, so far as I know, that has been published on motion study and on time study. That is, the motion study and time study of the cement and concrete trades. It contains everything relating to concrete work. It is of about seven hundred pages, and embodies the motions of men, the time and the best way of doing that sort of work. It is the first case in which a trade has been reduced to the same condition that engineering data of all kinds have been reduced, and it is this sort of data that is bound to sweep the world.

I have before me something which has been gathering for about fourteen years, the time or motion study of the machine shop. It will take probably four or five years more before the first book will be ready to publish on that subject. There is a collection of sixty or seventy thousand elements affecting machine-shop work. After a few years, say three, four or five years more, some one will be ready to publish the first book giving the laws of the movements of men in the machine shop—all the laws, not only a few of them. Let me predict, just as sure as the sun shines, that is going to come in every trade. Why? Because it pays, for no other reason. That results in doubling the output in any shop. Any device which results in an increased output, is bound to come in spite of all opposition, whether we want it or not. It comes automatically.

### THE SELECTION OF THE WORKMAN

The next of the four principles of scientific management is the scientific selection of the workman, and then his progressive development. It becomes the duty under scientific management, of not one, but of a group of men on the management side, to deliberately study the workmen who are under them; study them in the most careful, thorough and painstaking way, and not just leave it to the poor, overworked foreman to go out and say, "Come on, what do you want? If you are cheap enough I will give you a trial."

That is the old way. The new way is to take a great deal of trouble in selecting the workmen. The selection proceeds year after year. And it becomes the duty of those engaged in scientific management to know something about the workmen under them. It becomes their duty to set out deliberately to train the workmen in their employ to be able to do a better and still better class of work than ever before, and to then pay them higher wages than ever before. This deliberate selection of the workmen is the second of the great duties that devolve on the management under scientific management.

### BRINGING TOGETHER THE SCIENCE AND THE MAN

The third principle is the bringing together of this science of which I have spoken and the trained workmen. I say bringing because they don't come together unless some one brings them. Select and train your workmen all you may, but unless there is some one who will make the men and the science come together, they will stay apart. The "make" involves a great many elements. They are not all disagreeable elements. The most important and largest way of "making" is to do something nice for the man whom you wish to make come together with the science. Offer him a plum, something that is worth while. There are many plums offered to those who come under scientific management—better treatment, more kindly treatment, more consideration for their wishes, and an opportunity for them to express their wants freely. That is one side of the "make." An equally important side is, whenever a man will not do what he ought, to either make him do it or stop it. If he will not do it, let him get out. I am not talking of any mollycoddle. Let me disabuse your minds of any opinion that scientific management is a mollycoddle scheme.

I have a great many union friends. I find they look with especial bitterness on this word "make." They have been used to doing the "making" in the past. That is the attitude of the trade unions, and it softens matters greatly when you can tell them the facts, namely, that in our making the science and the men come together, nine-tenths of our trouble comes with the men on the management side in making them do their new duties. I am speaking of those who have been trying to change from the old system to the new. Nine-tenths of our troubles come in trying to make the men on the management side do what they ought to do, to make them do the new duties, and take on these new burdens, and give up their old duties. That softens this word "make."

### THE PRINCIPLE OF THE DIVISION OF WORK

The fourth principle is the plainest of all. It involves a complete re-division of the work of the establishment. Under the old scheme of management, almost all of the work was done by the workmen. Under the new, the work of the establishment is divided into two large parts. All of that work which formerly was done by the workmen alone is divided into two large sections, and one of those sections is handed over to the management. They do a whole division of the work formerly done by the workmen. It is this real co-operation, this genuine division of the work between the two sides, more than any other element which accounts for the fact that there never will be strikes under scientific management. When the workman realizes that there is hardly a thing he does, that does not have to be preceded by some act of preparation on the part of the management, and when that workman realizes when the management falls down and does not do its part, that he is not only entitled to a kick, but that he can register that kick in the most forcible possible way, he cannot quarrel with the men over him. It is team work. There are more complaints made every day on the part of the workmen that the men on the management side fail to do their duties, than are made by the management that the men fail. Every one of the complaints of the men have to be heeded, just as much as the complaints from the management that the workmen do not do their share. That is characteristic of scientific management. It represents a democracy, co-operation, a genuine division of work which never existed before in this world.

### THE PROOF OF THE THEORY

I am through now with the theory. I will try to convince you of the value of these four principles by giving you some practical illustrations. I hope that you will look for these four elements in the illustrations. I shall begin by trying to show the power of these four elements when applied to the greatest kind of work I know of that is done by man. The reason I have heretofore chosen pig-iron for an illustration is that it is the lowest form of work that is known.

A pig of iron weighs about ninety-two pounds on an average. A man stoops down, and with no other implement than his hands, picks up a pig of iron, walks a few yards with it, and drops it on a pile. A large part of the community has the impression that scientific management is chiefly handling pig-iron. The reason I first chose pig-iron for an illustration is that, if you can prove to any one the strength, the effect, of those four principles when applied to such rudimentary work as handling pig-iron, the presumption is that it can be applied to something better. The only way to prove it is to start at the bottom and show those four principles all along the line. I am sorry I cannot, because of lack of time, give you the illustration of handling pig-iron. Many of you doubt whether there is much of any science in it. I am going to try to prove later with a high class mechanic, that the workman who is fit to work at any type of work is almost universally incapable of understanding the principles without the help of some one else. I will use shoveling because it is a shorter illustration, and I will try to show what I mean by the science of shoveling, and the power which comes to the man who knows the science of shoveling. It is a high art compared with pig-iron handling.

### THE SCIENCE OF SHOVELING

When I went to the Bethlehem Steel Works, the first thing I saw was a gang of men unloading rice coal. They were a splendid set of fellows, and they shoveled fast. There was no loafing at all. They shoveled as hard as you could ask any man to work. I looked with the greatest of interest for a long time, and finally they moved off rapidly down into the yard to another part of the yard and went right at handling iron ore. One of the main facts connected with that shoveling was that the work those men were doing was that, in handling the rice coal, they had on their shovels a load of 3 3-4 pounds, and when the same men went to handling ore with the same shovel, they had over 38 pounds on their shovels. Is it asking too much of any one to inquire whether 3 3-4 pounds is the right load for a shovel, or whether 38 pounds is the right load for a shovel? Surely if one is right the other must be wrong. I think that is a self-evident fact, and yet I am willing to bet that that is what workmen are doing right now in Cleveland.

That is the old way. Suppose we notice that fact. Most of us do not notice it because it is left to the foreman. At the Midvale works, we had to find out these facts. What is the old way of finding them out? The old way was to sit down and write one's friends and ask them the question. They got answers from contractors about what they thought it ought to be, and then they averaged them up, or took the most reliable man, and said, "That is all right; now we have a shovel load of so much." The more common way is to say, "I want a good shovel foreman." They will send for the foreman of the shovelers and put the job up to him to find what is the proper load to put on a shovel. He will tell you right off the bat. I want to show you the difference under scientific management.

Under scientific management you ask no one. Every little trifle,—there is nothing too small,—becomes the subject of experiment. The experiments develop into a law; they save money; they increase the output of the individual and make the thing worth while. How is this done? What we did in shoveling experiments was to deliberately select two first class shovelers, the best we knew how to get. We brought them into the office and said, "Jim and Mike, you two fellows are both good shovelers. I have a proposition to make to you. I am going to pay you double wages if you fellows will go out and do what I want you to do. There will be a young chap go along with you with a pencil and a piece of paper, and he will tell you to do a lot of fool things, and you will do them, and he will write down a lot of fool things, and you will think it is a joke, but it is nothing of the kind. Let me tell you one thing; if you fellows think that you can fool that chap you are very much mistaken, you cannot fool him at all. Don't get it through your heads you can fool him. If you take this double wages, you will be straight and do what you are told." They both promised and did exactly what they were told. What we told them was this: "We want you to start in and do whatever shoveling you are told to do, and work at just the pace, all day long, that when it comes night you are going to be good and tired, but not tired out. I do not want you exhausted or anything like that, but properly tired. You know what a good day's work is. In other words, I do not want any loafing business or any overwork business. If you find yourself over-worked and getting too tired, slow down." Those men did that, and did it in the most splendid kind of a way day in and day out. We proved their co-operation because they were in different parts of the yard, and they both got near enough the same results. Our results were duplicated.

I have found that there are a lot of schemes among my working friends, but no more among them than among us. They are good, straight fellows if you only treat them right, and put the matter up squarely to them. We started in at a pile of material, with a very large shovel. We kept innumerable, accurate records of all kinds, some of them useless. Thirty or forty different items were carefully observed about the work of those two men. We counted the number of shovelfuls thrown in a day. We found with a weight of between thirty-eight and thirty-nine pounds on the shovel, the man made a pile of material of a certain height. We then cut off the shovel, and he shoveled again and with a thirty-four pound load his pile went up and he shoveled more in a day. We again cut off the shovel to thirty pounds, and the pile went up again. With twenty-six pounds on the shovel, the pile again went up, and at twenty-one and one-half pounds the men could do their best. At twenty pounds the pile went down, at eighteen it went down, and at fourteen it went down, so that they were at the peak at twenty-one and one-half pounds. There is a scientific fact. A first class shoveler ought to take twenty-one and one-half pounds on his shovel in order to work to the best possible advantage. You are not giving that man a chance unless you give him a shovel which will hold twenty-one pounds.

The men in the yard were run by the old fashioned foreman. He simply walked about with them. We at once took their shovels away from them. We built a large labor tool room which held ten to fifteen different kinds of shoveling implements so that for each kind of material that was handled in that yard, all the way from rice coal, ashes, coke, all the way up to ore, we would have a shovel that would just hold twenty-one pounds, or average twenty-one. One time it would hold eighteen, the next twenty-four, but it will average twenty-one.

When you have six hundred men laboring in the yard, as we had there, it becomes a matter of quite considerable difficulty to get, each day, for each one of those six hundred men, engaged in a line one and one-half to two miles long and a half mile wide, just the right shovel for shoveling material. That requires organization to lay out and plan for those men in advance. We had to lay out the work each day. We had to have large maps on which the movements of the men were plotted out a day in advance. When each workman came in in the morning, he took out two pieces of paper. One of the blanks gave them a statement of the implements which they had to use, and the part of the yard in which they had to work. That required organization planning in advance.

One of the first principles we adopted was that no man in that labor gang could work on the new way unless he earned sixty per cent higher wages than under the old plan. It is only just to the workman that he shall know right off whether he is doing his work right or not. He must not be told a week or month after, that he fell down. He must know it the next morning. So the next slip that came out of the pigeon hole was either a white or yellow slip. We used the two colors because some of the men could not read. The yellow slip meant that he had not earned his sixty per cent higher wages. He knew that he could not stay in that gang and keep on getting yellow slips.

### TEACHING THE MEN

I want to show you again the totally different outlook there is under scientific management by illustrating what happened when that man got his yellow slips. Under the old scheme, the foreman could say to him, "You are no good, get out of this; no time for you, you cannot earn sixty per cent higher wages; get out of this! Go!" It was not done politely, but the foreman had no time to palaver. Under the new scheme what happened? A teacher of shoveling went down to see that man. A teacher of shoveling is a man who is handy with a shovel, who has made his mark in life with a shovel, and yet who is a kindly fellow and knows how to show the other fellow what he ought to do. When that teacher went there he said, "See here, Jim, you have a lot of those yellow slips, what is the matter with you? What is up? Have you been drunk? Are you tired? Are you sick? Anything wrong with you? Because if you are tired or sick we will give you a show somewhere else." "Well, no, I am all right." "Then if you are not sick, or there is nothing wrong with you, you have forgotten how to shovel. I showed you how to shovel. You have forgotten something, now go ahead and shovel and I will show you what is the matter with you." Shoveling is a pretty big science, it is not a little thing.

If you are going to use the shovel right you should always shovel off of an iron bottom; if not an iron bottom, a wooden bottom; and if not a wooden bottom a hard dirt bottom. Time and again the conditions are such that you have to go right into the pile. When that is the case, with nine out of ten materials it takes more trouble and more time and more effort to get the shovel into the pile than to do all the rest of the shoveling. That is where the effort comes. Those of you again who have taught the art of shoveling will have taught your workmen to do this. There is only one way to do it right. Put your forearm down onto the upper part of your leg, and when you push into the pile, throw your weight against it. That relieves your arm of work. You then have an automatic push, we will say, about eighty pounds, the weight of your body thrown on to it. Time and again we would find men whom we had taught to shovel right were going at it in the old way, and of course they could not do a day's work. The teacher would simply stand over that fellow and say, "There is what is the matter with you, Jim, you have forgotten to shovel into the pile."

You are not interested in shoveling, you are not interested in whether one way or the other is right, but I do hope to interest you in the difference of the mental attitude of the men who are teaching under the new system. Under the new system, if a man falls down, the presumption is that it is our fault at first, that we probably have not taught the man right, have not given him a fair show, have not spent time enough in showing him how to do his work.

Let me tell you another thing that is characteristic of scientific management. In my day, we were smart enough to know when the boss was coming, and when he came up we were apparently really working. Under scientific management, there is none of that pretense. I cannot say that in the old days we were delighted to see the boss coming around. We always expected some kind of a roast if he came too close. Under the new, the teacher is welcomed; he is not an enemy, but a friend. He comes there to try to help the man get bigger wages, to show him how to do something. It is the great mental change, the change in the outlook that comes, rather than the details of it.

### DOES SCIENTIFIC MANAGEMENT PAY?

It took the time of a number of men for about three years to study the art of shoveling in that yard at the Bethlehem Steel Works alone. They were carefully trained college men, and they were busy all the time. That costs money, the tool room costs money, the clerks we had to keep there all night figuring up how much the men did the day before cost money, the office in which the men laid out and planned the work cost money. The very fair and proper question, the only question to ask is "Does it pay?" because if scientific management does not pay, there is nothing in it; if it does not pay in dollars and cents, it is the rankest kind of nonsense. There is nothing philanthropic about it. It has got to pay, because business which cannot be done on a profitable basis ought not to be done on a philanthropic basis, for it will not last. At the end of three and one-half years we had a very good chance to know whether or not it paid.

Fortunately in the Bethlehem Steel Works they had records of how much it cost to handle the materials under the old system, where the single foreman led a group of men around the works. It costs them between seven and eight cents a ton to handle materials, on an average throughout the year. After paying for all this extra work I have told you about, it cost between three and four cents a ton to handle materials, and there was a profit of between seventy-five and eighty thousand dollars a year in that yard by handling those materials in the new way. What the men got out of it was this: Under the old system there were between four and six hundred men handling the material in that yard, and when we got through there were about one hundred and forty. Each one was earning a great deal more money. We made careful investigation and found they were almost all saving money, living better, happier, they are the most contented set of laborers to be seen anywhere. It is only by this kind of justification, justification of a profit for both sides, an advantage to both sides, that scientific management can exist.

I would like to give you one more illustration. I want to try to prove to you that even the highest class mechanic cannot possibly understand the philosophy of his work, cannot possibly understand the laws under which he has to operate. There is a man who has had a high school education, an ingenious fellow who courts variety in life, to whom it is pleasant to change from one kind of work to another. He is not a cheap man, he is rather a high grade man among the machinists of this country. The case of which I am going to tell you is one in which my friend Barth went to introduce scientific management in the works of an owner, who, at between 65 and 70 years of age, had built up his business from nothing to almost five thousand men. They had a squabble, and after they got through, Mr. Barth made the proposition, "I will take any machine that you use in your shop, and I will show you that I can double the output of that machine." A very fair machine was selected. It was a lathe on which the workman had been working about twelve years. The product of that shop is a patented machine with a good many parts, 350 men working making those parts year in and year out. Each man had ten or a dozen parts a year.

The first thing that was done was in the presence of the foreman, the superintendent and the owner, of the establishment. Mr. Barth laid down the way in which all of the parts were to be machined on that machine by the workman. Then Mr. Barth, with one of his small slide rules, proceeded to analyze the machine. With the aid of this analysis, which embodies the laws of cutting metals, Mr. Barth was able to take his turn at the machine; his gain was from two and one-half times to three times the amount of work turned out by the other man. This is what can be done by science as against the old rule of thumb knowledge. That is not exaggeration, the gain is as great as that in many cases.

Let me tell you something. The machines of this country, almost universally in the machine shops of our country, are speeded two or three hundred per cent wrong. I made that assertion before the tool builders in Atlantic City. I said, "Gentlemen, in your own shops, many of your machines are two and three hundred per cent wrong in speeds. Why? Because you have guessed at it." I am trying to show you what are the losses under the old opinions, the difference between knowledge on the one hand and guesswork on the other.

In 1882, at the end of a long fight with the machinists of the Midvale Steel Works, I went there as a laborer, and finally became a machinist after serving my apprenticeship outside. I finally got into the shop, and worked up to the place of a clerk who had something wrong with him. I then did a little bit more work than the others were doing, not too much. They came to me and said, "See here, Fred, you are not going to be a piecework hog." I said, "You fellows mean that you think I am not going to try to get any more work off these machines? I certainly am. Now I am on the other side, and I am going to be straight with you, and I will tell you so in advance." They said, "All right then, we will give you fair notice you will be outside the fence inside of six weeks." Let me tell you gentlemen, if any of you have been through a fight like that, trying to get workmen to do what they do not want to do, you will know the meanness of it, and you will never want to go into another one. I never would have gone into it if I had known what was ahead of me. After the meanest kind of a bitter fight, at the end of three years, we fairly won out and got a big increase in output. I had no illusion at the end of that time as to my great ability or anything else. I knew that those workmen knew about ten times as much as I did about doing the work. I set out deliberately to get on our side some of that knowledge that those workmen had.

Mr. William Sellers was the president, and he was a man away beyond his generation in progress. I went to him and said, "I want to spend quite a good deal of money trying to educate ourselves on the management side of our works. I do not know much of anything, and I am just about in the same condition as all the rest of the foremen around here." Very reluctantly, I may say, he allowed us to start to spend money. That started the study of the art of cutting metals. At the end of six months, from the standpoint of how to cut the metal off faster, the study did not amount to anything, but we unearthed a gold mine of information. Mr. Sellers laughed at me, but when I was able to show him the possibilities that lay ahead of us, the number of things we could find out, he said, "Go ahead." So until 1889, that experiment went straight ahead day in and day out. That was done because it paid in dollars and cents.

After I left the Midvale Steel Works, we had no means of figuring those experiments except the information which we had already gotten. Ten different machines were built to develop the art of cutting metals, so that almost continuously from 1882 for twenty-six years, all sorts of experiments went on to determine the twelve great elements that go to make up the art of cutting metals. I am trying to show you just what is going to take place in every industry throughout this world. You must know those facts if you are going to manufacture cheaply, and the only way to know them is to pay for them.

### THE DISCOVERY OF HIGH SPEED STEEL

Twelve elements do not sound very many, but they are difficult elements. One of the twelve elements was the discovery of high speed steel, that is, it resulted from a careful series of experiments to determine the proper chemical composition, plus the proper heat treatment of tool steel in order to get the highest cutting speed out of it. It was a series of most carefully tried scientific experiments lasting through three years, which led gradually up to the discovery of high speed steel. Most people think it was an accident. Not at all. It was at the expense of about $50,000 in work, in wages, and in the manufacture of steels. That is one of the twelve elements. There are eleven others. Among the others is this one, simplest of all. We found very early that if we threw a heavy stream of cold water on the tip of the tool, the cooling effect was such that we could run forty per cent faster. Mr. Sellers was skeptical, and it was pretty hard to make him believe the truth. He tore down the old shop and built an entirely new shop in order to get that forty per cent increase. He had his overhead supply of water brought down to each machine so that it could be adjusted quickly, and by means of that it gave us that forty per cent increase. Gentlemen, think of it, only one machine shop in twenty years followed that. It was explained to the manufacturers, and the average man said, "Oh, hell, what's the use." There is the answer.

I also want to try to show you why the high class mechanic cannot possibly compete with this science. The working out of those twelve elements resulted in the development of twelve large mathematical formulas, and in order to figure out the two great things that every mechanic has to know when he sets a tool in a lathe and goes to cutting metals,—what speed and what feed shall be used,—requires the solution of a mathematical problem containing twelve unknown quantities. If any one tries to solve those twelve unknown quantities with a pencil and paper, it takes about six hours. For eighteen years we had mathematicians all the time employed trying to solve that problem, and it paid because we got nearer and nearer to the solution. At the end of eighteen years, instead of taking six hours to solve the problem, it can be solved in twenty seconds by all of the workmen. That brings this problem right down to the level of every day practical common sense.

### THE EFFECT ON THE WORKMAN

Almost every one says, "Why, yes, that may be a good thing for the manufacturer, but how about the workmen? You are taking all the initiative away from that workman, you are making a machine out of him; what are you doing for him? He becomes merely a part of the machine." That is the almost universal impression. Again let me try to sweep aside the fallacy of that view by an illustration. The modern surgeon without a doubt is the finest mechanic in the world. He combines the greatest manual dexterity with the greatest knowledge of implements and the greatest knowledge of the materials on which he is working. He is a true scientist, and he is a very highly skilled mechanic.

How does the surgeon teach his trade to the young men who come to the medical school? Does he say to them, "Now, young men, we belong to an older generation than you do, but the new generation is going to far outstrip anything that has been done in our generation; therefore, what we want of you is your initiative. We must have your brains, your thought, with your initiative. Of course, you know we old fellows have certain prejudices. For example, if we were going to amputate a leg, when we come down to the bone we are accustomed to take a saw, and we use it in that way and saw the bone off. But, gentlemen, do not let that fact one minute interfere with your originality, with your initiative, if you prefer an axe or a hatchet." Does the surgeon say this? He does not. He says, "You young men are going to outstrip us, but we will show you how. You shall not use a single implement in a single way until you know just which one to use, and we will tell you which one to use, and until you know how to use it, we will tell you how to use that implement, and after you have learned to use that implement our way, if you then see any defects in the implements, any defects in the method, then invent; but, invent so that you can invent upwards. Do not go inventing things which we discarded years ago."

That is just what we say to our young men in the shops. Scientific Management makes no pretense that there is any finality in it. We merely say that the collective work of thirty or forty men in this trade through eight or ten years has gathered together a large amount of data. Every man in the establishment must start that way, must start our way, then if he can show us any better way, I do not care what it is, we will make an experiment to see if it is better. It will be named after him, and he will get a prize for having improved on one of our standards. There is the way we make progress under scientific management. There is your justification for all this. It does not dwarf initiative, it makes true initiative. Most of our progress comes through our workmen, but it comes in a legitimate way.